As will be discussed in sections 3 and 4 below, although PSTN congestion can *potentially* occur at each of these three points in the public network, the BOCs' studies cite examples of ISP-related congestion at only a single point on the network — the switch that terminates calls to the ISP (Element 5).

A closer examination of the components of a typical Class 5 switch helps clarify how the switch operates, and identifies the limited portions of the switch architecture in which blocking can occur.

Figures 2 and 3 present detailed diagrams of the principal components of a modern digital electronic central office switch. Low-use subscriber lines are terminated at "line ports" on the Line Concentration Module (LCM) which permits a relatively large number of individual lines to share a smaller group of paths through the switching matrix.

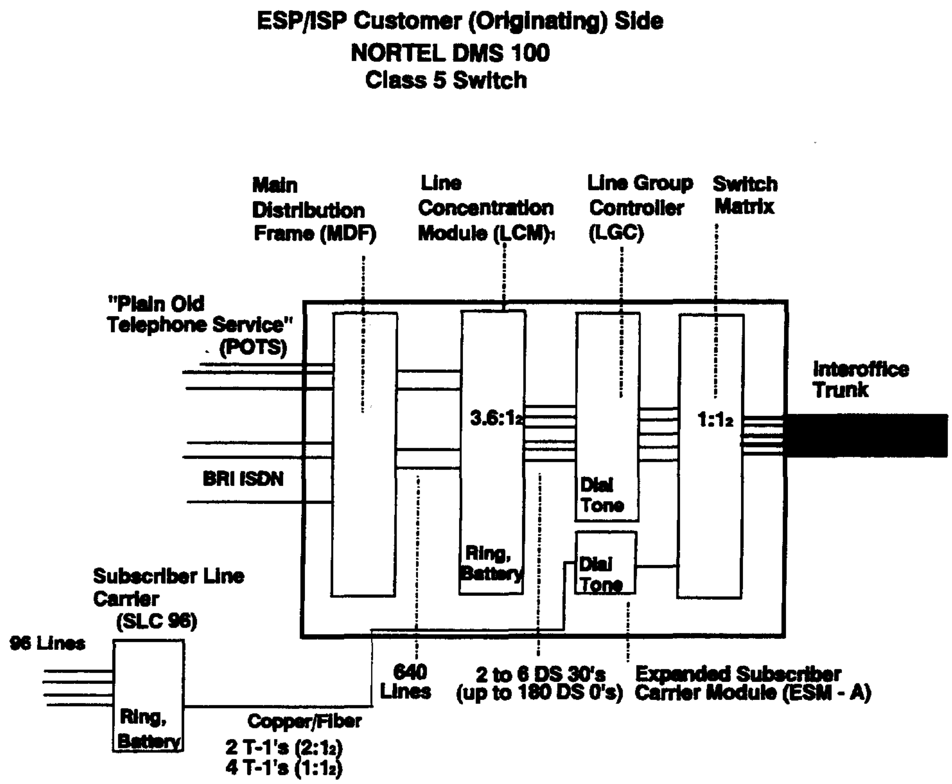
A central office switch typically serves about 20,000 subscriber lines, requiring up to 32 LCMs. Very large urban central office switches may contain as many as 156 LCMs.[15] In the Nortel DMS-100, up to 640 lines can be terminated in each LCM to share up to 180 paths. Put another way, a maximum of 180 out of the 640 lines can be in use at any point in time; the 181st subscriber will not receive dial tone until one of the other 180 subscribers has hung up, and calls placed to the 181st subscriber (when all 180 paths are in use) will receive a fast busy ("reorder") tone. In its standard configuration, the AT&T (now Lucent Technologies) 5ESS can accommodate up to a maximum of 512 subscriber lines sharing up to 64 ports, although with somewhat less flexibility than under the DMS-100 architecture.[16] These subscriber lines terminate at the Line Unit (LU) of the 5ESS switch, which performs a concentration function analogous to that of the LCM of the DMS-100.

If the usage characteristics of the lines terminating at a particular LCM are such that more than 180 would be off-hook during the peak period for the group, there are several engineering choices available to the local telephone company. The company can attempt to balance the traffic across the various LCMs in the switch by intermixing subscriber lines with *non-coincident peaking* characteristics. For example, by mixing business lines that make few calls during the evening with residential lines that make few calls during the day, a smaller number of lines in the LCM will be concurrently competing for the limited number of paths. Alternatively, the telephone company can reduce the number of lines that

15. While even larger central office facilities are technically feasible, the sheer size of the switching equipment required makes them impractical in nearly all situations.

16. AT&T, *5ESS Switch: The Premier Solution. Information Guide*. AT&T Network Systems, 1987, at 20.

it terminates on an individual LCM, such that up to half of the total lines in the LCM can be off-hook, rather than only about 1/4th of them in the fully loaded configuration.[17]



NOTES: 1.The Enhanced LCM (LCME) used to provide Basic Rate ISDN, can potentially support up to 480 BRI ISDN connections. Additionally, it is possible to configure an LCME in a non-blocking mode, which would support 239 BRI connections.
2. Ratios represent the contration of lines /trunks at a given switch element.

Figure 2. A diagram of the components of a Nortel DMS-100 switch serving an ESP customer (Element 2 of Figure 1).

17. Reducing the number of lines terminating at an LCM — or "deloading" the LCM — will result in some increase in the average cost per actual line termination, since the fixed cost of the LCM itself (a cabinet with associated wiring and power supply) will have to be spread across fewer lines. Thus, if the LCM is fully loaded, then its common equipment cost can be divided up among 640 subscriber lines; if only 320 lines are terminated, the per-line LCM common equipment cost will be doubled. Other costs that vary on a per-line basis, such as plug-in line termination cards, are not affected by the number of such cards that populate a particular LCM.

The cost of operating the PSTN and many of its components is sensitive to the *peak demand* placed on each network resource and to the relationship between that peak demand and the aggregate capacity of the individual network components. Off-peak use — and even significant growth thereof — does not materially impact network capacity or operating costs.[18] Moreover, certain network components are designed with substantially more capacity than is required even at peak periods, and are for most practical purposes *non-blocking* even at peak times. These include fiber optic interoffice cables and associated digital carrier systems and central office switching capacity. Because of the high fixed costs associated with their initial placement, fiber optic cables typically contain numerous individual "strands," only some of which are "lit" — i.e., equipped with electronics — when the cable is initially deployed. Additional traffic capacity can be readily augmented either by installing additional electronics on working ("lit") strands, or by equipping "dark" strands with electronic terminating gear. Switching systems similarly have high fixed processor costs, but the processor can typically handle substantially more traffic than is normally required by typical line/trunk configurations. "Non-blocking" switch elements are provisioned on a one-to-one basis, so the capacity of the switch is not constrained by their use. Thus, even when traffic loads increase to a point where additional peak-hour capacity must be provided, the incremental cost of this capacity will typically be far less than simply a proportionate expansion of the preexisting peak-hour capacity cost.[19] Non-blocking architectures are particularly common in modern digital central office switches, such as the Nortel DMS-100.[20]

---

18. One notable exception to this rule is the *transaction cost* associated with using measurement and call detail accounting for billing purposes, whose costs are generally sensitive to total calling volumes rather than to peak-load conditions. Numerous studies and regulatory decisions have found that the magnitude of such transaction costs exceeds the economic gains attributable to measured-use pricing of local calling — particularly where such use is heavily or primarily during off-peak periods — the case for most residential subscribers. *See*, for example, Rolla Edward Park and Bridger M. Mitchell, *Optimal Peak-Load Pricing for local Telephone Calls*, Santa Monica, California: The Rand Corporation, Publication number R-3404-1-RC, March, 1987; and William Taylor, *Generic Costing and Pricing Problems in the New Network: How Should Costs be Defined and Assessed?*, presented at the Twentieth Annual Williamsburg Conference, Institute of Public Utilities, Graduate School of Business Administration, Michigan State University, December 5-7, 1988, at pp. 10-11. *See, also,* Michigan PSC, *In the matter of the application of Michigan Bell Telephone Company for authority to revise its schedule of rates and charges*, Case No. U-7473, April 26, 1984; and Delaware PSC, *In the matter of the proposed amortization of the Diamond State Telephone Company's Straight-Line Depreciation Reserve...*, Order No. 3216, 120 P.U.R.4th 121, November 2, 1990.

19. That is, the incremental cost of increasing the busy-hour capacity of a switch by 10% from, say, 100,000 calls to 110,000 calls, will be well below 10% of the capital cost of the original (100,000-call) capacity.

20. Figures 2 and 3 present schematic diagrams of the components of a Nortel DMS-100 Switch. Figure 2 shows various methods by which residential lines terminate at the switch. As the figure makes clear, unless a subscriber is served by a Subscriber Line Carrier (SLC-96), analog subscriber lines and BRI ISDN lines both terminate in the Line Concentration Module (LCM), which connects all incoming lines (up to 640) with up to 180 outgoing trunks. As has been stated previously, the LCM is the switch component where blocking is most likely to occur.

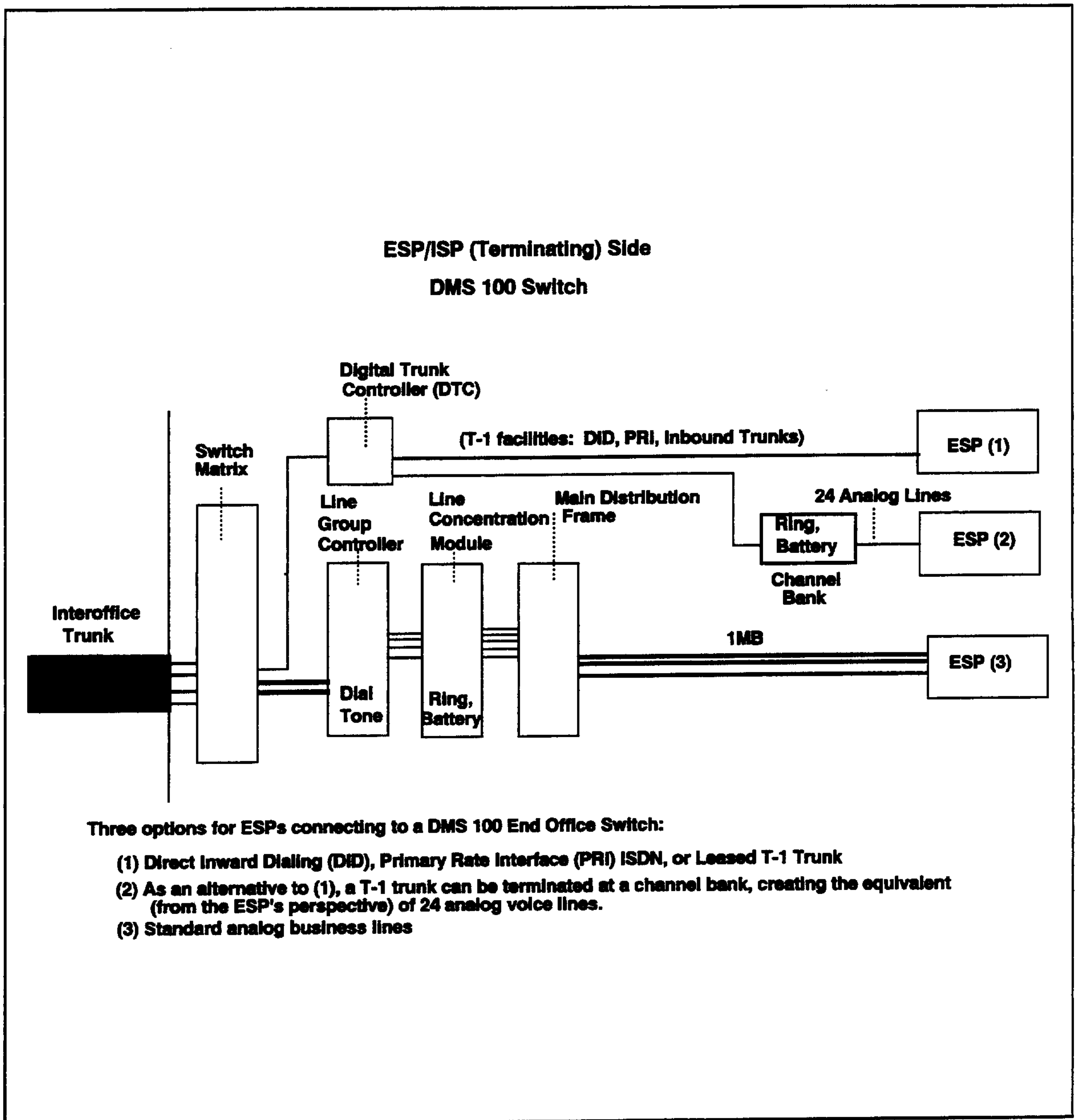


Figure 3. A schematic diagram of a Nortel DMS-100 Switch that terminates calls to an ESP (Element *5* of Figure 1), depicting three routes by which calls can be transported to the ESP.

ILEC tariffs often apply premium charges for, and thus deter use of, the most efficient service configuration for high-use subscriber lines.

The purpose of the Line Concentration Module, as its name implies, is to perform a *concentration* function. Ordinarily, it would not be economical to assign a dedicated switch path to each subscriber line, because on average an individual subscriber line is in use for only a small portion of the busy hour (that is, the hour in which the switch experiences its heaviest usage). However, in some cases individual lines may be used very heavily, perhaps for most of the full busy hour.[21] Lines that carry concentrations of traffic to and/or from a larger community of end users, such as PBX trunks and ISP/ESP access lines, can sometimes be more efficiently served by *bypassing* the Line Concentration Module and instead directly accessing a dedicated *trunk port* on the central office switch. Functionally, this is the same type of trunk port that is shared by the larger number of lines connected to the LCM (see Figure 3), but avoids the line contention and potential congestion at — as well as the plug-ins and common equipment costs of — the LCM itself. If the ISP access lines terminate directly in trunk ports, the "dial tone contention problem" is essentially eliminated, since the ISP's lines are no longer competing for the same limited group of switch paths with ordinary business and residential subscriber lines.

BOC tariffs, in fact, provide for such trunk terminations. LECs sometimes use T-1 lines to provide service to a customer who orders a large number of access lines, using a channel bank to convert the T-1 into the equivalent of 24 analog access lines, and charging as if it were offering 24 standard voice business lines. This approach, which is essentially transparent to the customer, is represented by Option 2 in Figure 3, and is generally used when the LEC concludes that installing 24 individual voice-grade (DS-0) lines would be less efficient than providing a single T-1.[22] However, if the subscriber desiring a T-1

---

21. The most common case in which this occurs is with private branch exchange (PBX) trunks. A PBX trunk is a subscriber line that connects the central office with switching equipment that is physically located at the customer's premises, to which a larger number of individual PBX extensions may be connected. Because the PBX trunks are used to concentrate traffic for a larger number of extensions, their average use is much greater than for ordinary business lines. This relationship has long been recognized in local telephone company tariffs — in jurisdictions in which businesses may subscribe for "flat-rate" service, PBX trunks are priced as much as 50% to 100% above the applicable rate for an ordinary (non-PBX) business access line to reflect the relatively greater volume, if not necessarily the relative cost, of calls originated on the trunk. Since the total number of PBX trunks that a customer will require is directly related to the customer's busy hour traffic load, the pricing of PBX trunks — even in flat-rate jurisdictions — is more accurately described as a "demand-sensitive" price, where the total charge to be paid by the customer is directly related to the concurrent peak demand (number of simultaneous calls) that customer imposes upon the PSTN.

22. Typically, 24 voice-grade or DS-0 lines will require the use of 24 individual subscriber loops, whereas a T-1 digital access line with a bandwidth of 1.544 mbps (equivalent to 24 – 64 kbps voice-grade digital channels) requires only *two* subscriber loops. The trade-off here is additional loops versus additional terminating equipment at the subscriber premises and the central office. Where distances are short and/or where loop pairs are plentiful,
(continued...)

trunk arrangement orders it directly, the ILEC's tariff often provides a very different rat structure. Generally, the subscriber orders a DS-1 (T-1) capacity (1.544 mbps) digita channel providing 24 DS-0 digital voice-grade 64 kbps channels, either over a fiber optic cable or via two copper pairs. The subscriber pays the applicable rate for a DS-1 loca channel (typically $150 to $300 per month). In addition, the subscriber pays for each DS-(termination on the central office switch, often at the prevailing PBX trunk rate, and in some cases may be subject to additional charges as well.

State (RBOC)	Measured Business Lines	Hunt Group Charge	24 Business Lines, in Hunt Group	Digital Trunk Group	PRI ISDN
New York (NYNEX)	$22.23	None	$533.52	$1502.45	$1,008.93
California (Pacific Telesis)	$16.32	$0.50	$403.68	$515.48 - $715.48	$524.90 - $724.90
Maryland (Bell Atlantic)	$19.34	$0.52	$476.64	$1212.16	$644.00
Oregon (U S West)	$24.00	$1.36	$608.64	$1134.00	$1,246.00

Table 1. Comparison of BOC tariffs for standard analog voice business lines, digital trunk groups, and PRI ISDN (the equivalent of 24 lines in each case). Sources: NYNEX New York State Intrastate Tariff, PSC 900 Sec. 4.E.36, PSC 900 Sec. 21.J, PSC 901 Sec. 2.C.1.b; PSC 901, Sec. C.1.b. Pacific Telesis California Intrastate Tariff, CAL PUC No. A5, Sec. 5.3.6, Sec. 5.3.C.4, Sec. 5.2.1; CAL PUC No. A18, Sec. 18.2. Bell Atlantic - Maryland, Inc., Maryland Intrastate Tariff, P.S.C. -Md. No. 203, Sec. 6.c, Sec. 14; No. 202, Sec. 2.C.2.a.(2); No. 203, Sec. 6.C. U S West Communications Oregon Intrastate Tariff, Sec. 15.1.D.1, Sec. 15.1.D.2, Sec. 5.2.1.D.1, Sec. 14.3; PUC Oregon No. 25, Sec. 5.2.5.A. 24 SLC charges are included for PRI ISDN, although this charge is not universally applied.

Table 1 summarizes the state tariffs for California, New York, Maryland, and Oregon (Pacific Bell, NYNEX, Bell Atlantic, and U S West, respectively), providing a comparison of measured business rates (including hunt-group charges) and the cost of a digital trunk

22. (...continued)
the individual line solution may be selected; for longer distances, and/or where pairs are scarce, the T-1 approach will be utilized.

group arrangement. The precise combination of tariffed services that is required to put together a digital trunk arrangement varies from state to state, and is not clearly defined in most state tariffs, making comparisons difficult. In New York, for example, the NYNEX tariff for its FlexPath Digital PBX service includes a charge of $533.06 for 24 ports, a Digital Termination Facility (DTF) charge of $435.87, a charge for 24 measured PBX trunks at $389.52, and a charge of $144 representing 24 Subscriber Line Charges ($6.00 each), for a combined total of $1,502.45, or $62.60 per voice-grade trunk.[23] Similarly, in California, Pacific Bell's tariffs would apply a high capacity (T-1) private line charge of between $150 and $350, a "Super-Trunk" termination charge of $211.48, a $10 trunk port charge, and a $144 subscriber line charge (24 lines at $6.00 each), for a combined total of between $515.48 and $715.48.[24] In all four states, however, the price comparison leads to the same conclusion: A hunt group of 24 analog voice lines is priced between 22% and 65% less than the equivalent trunk-side connection. The economic rationale for this price differential is difficult to understand.[25] While the cost of a trunk group does include the cost of the software and hardware that connects it to its serving end office switch, the price of a standard business line presumably covers analogous costs. Moreover, the price of a business line must also include significantly more in terms of distribution plant than a trunk group.

---

23. See Table 1, *supra*, for sources.

24. See Table 1, *supra*, for sources.

25. In fact, the FCC has recently taken note of the fact that the costs associated with T-1 PRI (Primary Rate Interface) ISDN service (which consists of 24 voice-grade "B" channels) is less than 24 times the cost of a single analog subscriber line. *See, Access Charge NPRM*, CC Docket 96-262, released December 24, 1996, at para. 70. The following cost data were provided, with average ratios computed with and without NYNEX, which the Commission suggested may be an outlier:

Ratio of Costs of Standard Analog Service to PRI ISDN Service*

	Outside Plant (loop only) costs	**Outside Plant (loop only) costs (excluding NYNEX)**	**All NTS costs**	**All NTS costs (excluding NYNEX data)**
Ameritech	1:5.68	1:5.68	1:8.9	1:8.9
Bell Atlantic	1:4.13	1:4.13	1:15.80	1:15.80
NYNEX	1:10.94	excluded	1:27.74	excluded
Pacific Bell	1:4.67	1:4.67	1:8.70	1:8.70
US West	1:5.33	1:5.33	1:10.60	1:10.60
Average ratio of costs	**1:6.5***	**1:4.95***	**1:15.13***	**1:10.5***

*Averages may differ due to rounding.

Since the business line rate *includes* a dedicated subscriber loop to the central office for each line, ordering 24 analog business lines requires, in theory, that the telephone company provide 24 individual loops to the central office, 24 line cards at the central office, and 24 line ports (for example, in the line concentration module (LCM) of the DMS-100 switch, Option 3 in Figure 3). In contrast, the use of T-1 capacity requires only two (2) loops for all 24 channels, no line cards or ports, and a single trunk port in the digital trunk controller (DTC) (Option 1 in Figure 3) and is therefore far less costly, in terms of network resources, for the telephone company to provide than standard analog service. Nevertheless, rather than reflect this efficiency, BOC tariffs (such as the previously discussed) typically charge more for the T-1 arrangement than for the less efficient analog service. Consequently, many PBX and other high-volume users who *should be served via T-1 lines and trunk port connectivity* are induced to order the less expensive (but potentially more costly to provide) analog service with LCM terminations.[26]

Disproportionate growth in off-peak demand by Internet and other on-line services users has the effect of reducing the average per-minute cost of local telephone network traffic for all PSTN users.

Finally, an understanding of the potential impact of increased network use upon ILEC costs requires a brief review of some of the basic arithmetic characteristic of capital-intensive industries such as local telephone networks. For this purpose, we offer the following numerical exercise. The average cost of PSTN usage (e.g., calls, minutes) can be calculated for any given PSTN resource by dividing the busy hour capacity cost of the resource by the *total usage* of the component. Thus, a switch with a busy hour capacity of 500,000 minutes may carry 150-million minutes over the course of a month.[27] If the total (capital and operating) cost of the switch is $250,000,[28] then the per-minute cost for the switch is $250,000/150-million, or $0.0017.

26. The use of trunk port connections by high-volume end users, such as large PBXs and ISPs, will largely eliminate the kind of switch congestion problems that some ILECs have reported. However, network congestion can still occur if the ILEC has failed to provide an adequate number of interoffice trunks to handle the traffic in and out of a given end office switch. This is a question of planning, and is a problem that can be readily avoided simply by providing adequate interoffice trunk capacity over all routes. As we discuss below in Section 3, ILECs receive compensatory revenues for the calling services they provide to and for ISPs that are more than sufficient to cover the costs incident to any required capacity expansion.

27. This relationship is based on the following assumptions: The busy hour represents 10% of the total daily use, and there are 30 business days per month.

28. This assumes a purchase cost for the switch of $10-million and a 0.30 annual composite carrying cost (i.e., $3-million per year, $250,000 per month).

Now, suppose that, as a result of increased off-peak (primarily residential) use of on-line services and the Internet, the total monthly use of the switch increases to 165-million minutes, but with no change in peak-hour demand. The average cost per minute will now be $0.0015 (i.e., $250,000/165-million), with no change in the total operating cost of the PSTN.

Finally, assume a "worst case" scenario under which most of the increased use was during the late evening hours, so that the office busy hour actually shifted from mid-afternoon to 10 pm, and the peak capacity demand increased from 500,000 minutes to 550,000. This will lead to a less-than-proportionate increase in capacity cost[29] (let's use 5% in this example), such that the monthly cost of the switch will be $262,500. However, at the new, increased monthly traffic volume of 165-million minutes, the average cost per minute will be $0.0016, *again less than the $0.0017 cost per minute prior to the growth in on-line traffic*. As discussed below, this usage also produces significant additional revenues from second lines. Thus even where the growth in Internet use, and additional lines ordered by the customer to support that use, causes the LEC to incur additional capacity costs, the incremental revenue gained will be more than sufficient to recover any modest increase in total network costs.

Any physical or functional similarity between PSTN use by interexchange carriers and by ISPs is both coincidental and immaterial, because such similarities also exist between IXC use and that of any number of other end users of local network applications.

One justification for the imposition of an access charge regime involves a perceived similarity between ESPs and IXCs in their usage of the PSTN. However, that there may be similarities in the concentration of local network traffic by IXCs and ISPs is neither surprising nor relevant. ISPs, like IXCs, use the ILEC network to aggregate traffic throughout a LATA for delivery to one, or at most a few, points of presence (POPs). But the use of the local network for traffic aggregation to a single point of collection is also done by any number of other large end users. Central office trunks serving large PBXs, automatic call distributors (ACDs), banks or other financial institutions, local radio station talk shows or call-in contests all exhibit traffic patterns and properties that are similar to those characteristic of IXC switched access trunks — i.e., high use at the point of concentration requiring transport over the local network between the PBX or ACD and the calling or called party.

29. Because the costs of many switch and network components are fixed, only *variable* costs will increase with an increase in peak demand. Hence, total network costs (i.e., fixed plus variable costs) will tend to rise proportionately less than the relative increase in total traffic-sensitive capacity.

For example, a medium-sized business might have a PBX that serves 900 individual station lines. Assuming a typical average busy hour use per PBX station line of 3 CCS, such a customer would require 97 PBX trunks in order to maintain a P.01 grade of service (i.e., one blocked call per 100 attempts).[30] Each of those PBX trunks would then carry, on average, approximately 28 CCS of traffic in the busy hour — a traffic volume that is comparable to those attributed to ESP/ISP use in the BOC studies and the Bellcore study.[31] Larger PBXs, with correspondingly greater numbers of station lines and trunks, can support even more intensive usage of those trunks at any given level of blocking (for example, at the P.01 grade of service mentioned above). A typical PBX system can, and indeed will, support high levels of trunk usage, with a level of blocking well within normal network tolerances. The usage levels for ESP trunks as cited by the BOCs are therefore not particularly noteworthy; indeed, they are found frequently among other large-volume end users.

PBXs are sometimes even designed to support a full 36 CCS per-trunk load. A PBX can be arranged to utilize queuing rather than contention for providing station lines with trunk access. Also, trunk groups designed for very intensive use can be engineered to fill to capacity, then pass overflow calls off to a separate, "final group" of trunks. In this case the high usage trunk group could well have a usage of 36 CCS, but this measurement would not provide the complete picture of how the PBX system in question uses the network. PBX trunk groups that support even full-capacity usage have existed in the context of voice telephony for decades without causing any "meltdown" of the local telephone network. There is no reason why comparable per-trunk traffic loads on lines used for data traffic should have any greater impact.

30. This calculation is derived from a Poisson trunk capacity table at a P.01 grade of service. 900 station lines with an average busy hour use of 3.0 CCS requires 2700 CCS busy hour capacity. 97 trunks would be required to support this level of demand with one blocked call per 100 attempts. Average utilization of each trunk in the group will be 28 CCS (i.e., 2700/97 out of a theoretical maximum utilization of 36 CCS per trunk).

31. The BOC studies claim peak hour traffic levels for ESPs using analog connections of 26 CCS (Bell Atlantic study, at 6); 27 CCS (US West study, based on peak usage of 45 minutes per hour); approximately 32 CCS (NYNEX Study, based on average of peaks for the ISPs for which data was provided in the Attachment); and an average ranging from 13 to 21 CCS, with some individual hunt groups at 30 CCS (Pacific Bell Study, at 2).

3 BOC INTERNET IMPACT STUDIES: GENERAL ASSESSMENT

The BOC studies that have been submitted to the FCC, as well as several recent claims made by senior BOC officials, overstate the severity of the congestion that may be caused by data traffic on the PSTN and ignore significant sources of revenue.

The primary evidence that the BOCs have offered regarding the impact of data traffic on the public switched telephone network is encapsulated in the studies that four of them (US West, Pacific Telesis, Bell Atlantic, and NYNEX) and Bellcore, have submitted to the FCC. These studies vary considerably both as to their length and level of detail, but all contend that Internet use causes congestion on their local telephone networks without compensating revenues to fund network changes needed to relieve this congestion.

None of the BOC studies, however, offers a comprehensive picture of the impact of ESP/ISP use on their networks and resources. Instead, the four BOC studies rely upon isolated, worst-case situations in which the specific central offices that were selected for examination happen in each case to directly serve one or more on-line service providers. In this section, we review the key features common to all of the BOC studies, detailing general flaws that, when corrected, refute BOC claims of any widespread congestion problem, and BOC assertions that they are not being compensated for ESP traffic.

The BOC studies rely entirely upon anecdotal evidence gleaned from a few isolated, worst-case central offices that were specifically selected because of their unusual traffic conditions.

The four BOC studies were highly selective in the exchanges and central office switches they examined. Of the approximately 5,200 central office switches in the territories of U S West, Pacific Telesis, NYNEX, and Bell Atlantic,[32] the BOCs selected only some 127 central office switches (or 2.4%) for inclusion in their studies. Moreover, of those central offices selected for study, only a very few had traffic patterns the might be

32. FCC, *Preliminary Statistics of Common Carriers*, 1995, Table 2.10.

considered problems. For example, Pacific Bell operates 790 central office switches in California.[33] However, only 29 central offices were selected for examination in the Pacific Telesis study, and of those only one was mentioned specifically as an example where data traffic constituted a significant fraction of total switch traffic.[34] Moreover, that central office was located in Silicon Valley, where Internet, ESP, and telecommuting usage patterns are in all probability far above average. Thus, while the Pacific Telesis study cites a general trend of longer holding times and later busy hours for ESPs in the state, it only points to specific data traffic conditions at a single switch that happens to be located in the midst of what may well be the largest concentration of computer industry professionals in the nation. Indeed, Pacific Telesis itself has recently started to adjust its position on the issue. According to John Britton, a Pacific Bell spokesman, the media reports of an impending meltdown are greatly exaggerated:

> The prospect of the network being overjammed would never happen. . . . The problem is only that one location [i.e., the Silicon Valley switch] during the evening. The state's phone network is not in trouble because of the Internet.[35]

As further evidence of Pacific Bell's recent retreat from claims of impending doom, in comments to the California Public Utilities Commission filed in November, the company stated:

> There has been no deterioration of service in our network. In fact, except for a temporary situation at one switching center which we corrected, we have maintained our usual standard of more than 99% of calls going through on the first attempt. We are committed to maintaining the quality of our network.[36]

Indeed, the fact that the network has *not* been placed in any sort of jeopardy by Internet and other data applications was underscored in November by Raymond F. Albers, the Chair-

33. FCC, *Preliminary Statistics of Common Carriers*, 1995, Table 2.10.

34. Pacific Telesis study at 2. Although Pacific's study also claims that it has experienced incremental expenses addressing ESP network impacts (*Id.*), how those expenses relate to the 29 central offices, or the single switch discussed, is ambiguous. However, later statements by the company (quoted subsequently in this study) make clear that from Pacific's perspective, only a single specific switch was considered a "problem."

35. "Out of a Jam: Pacific Bell's Answer to Congestion on the Net has some Competitors Skeptical," *San Jose Mercury News*, Friday, November 8, 1996 at 1C. The article makes clear that Mr. Britton is referring to the aforementioned Silicon Valley switch.

36. Reply Comments of Pacific Bell to Comments in Response to the Managing Commissioner's Ruling Concerning Market and Technical Conditions, California PUC, R.93-04-003, I.93-04-002, R.95-04-043, I.95-04-044, dated November 14, 1996, at 42.

man of the Network Reliability Steering Committee of the Alliance for Telecommunications Industry Solutions (ATIS), an organization of incumbent LECs. In a statement in response to BOC reports on the ISP issue, Albers stated that it was unlikely that Internet usage could cause "reportable" PSTN outages.[37]

In general, the BOC/Bellcore studies focus largely or entirely on the *terminating* end of the end-user-to-ESP connection. Costs, to the extent that they are attributable specifically to calls to ESPs and ISPs, are most easily measured at the terminating end, as the BOC studies attempt to do. However, *revenues* are almost entirely generated at the *originating* end of the call, which the studies essentially ignore. Hence, as the following simple diagram illustrates, it is not surprising that the studies reach the incorrect conclusion that costs exceed revenues.

	Origination	**Termination**
Revenues	High	Low
Costs	Low	Moderate

Table 2. Sources of BOC Costs and Revenues From Calls to ESPs.

It seems clear that when both the originating and terminating ends of ESP calls — and all relevant costs and revenues — are included, the BOC studies' conclusion can be soundly rejected.

37. "Internet 'Not to Blame' for Network Outages," *Telecommunications Reports*, November 4, 1996, at 32.

A careful examination of the various BOC impact studies compels the following specific conclusions.

While this report will in a later section identify the critical flaws in each of the BOC and Bellcore studies individually, analysis of the data presented in the studies collectively leads to two key conclusions.

Internet use is not responsible for disproportionately increased PSTN costs. The BOC studies all present a view of the impact of on-line service usage on their facilities at an anecdotal level, and offer no statistical or other support for the proposition that these isolated experiences can be extrapolated to the local network as a whole. The studies all focus upon specific cases of switches that serve ESPs/ISPs, and Bell Atlantic and Pacific Bell both quantify the expenses associated with modifications made to specific switches allegedly because of ESP traffic.[38] This overly narrow view of the PSTN fails to give an accurate picture of the broader impact of data traffic on the BOC networks as a whole.

Bell Atlantic, for example, discusses specific switch-related investments it claims were caused by ISP traffic, including estimated expenses in three instances.[39] Those expenditures ranged from $200,000 to some $2-million for a single switch. However, even if Bell Atlantic has spent as much as $2-million to upgrade a specific 5ESS switch that happens to serve an ISP (which, the Bell Atlantic study itself admits was an exceptionally high figure for such an upgrade),[40] the study offers no information as to how much the Company would have otherwise spent *on that same switching entity* for routine upgrades and capacity expansion *even if no consequential data communications traffic were present.* Central office switches are highly modular in their design. LECs typically configure a new switch with capacity sufficient to handle the initial demand, and periodically expand that capacity by adding line and trunk ports and other components as demand grows over time. In 1995 alone, Bell Atlantic spent more than $409-million on central office switch acquisitions and upgrades,[41] and the annual rate of expenditure on switching and other local network resources does not appear to have any direct relationship with the recent growth of the Internet. Hence, the $2.5-million in total expenditures that the Bell Atlantic

38. Pacific Telesis study, at 2; Bell Atlantic study, at 15.

39. Bell Atlantic study, at 9-13.

40. *Id.*, at 9-10.

41. ARMIS 43-02 Reports, 1995.

study ascribed to Internet demand for the specific cases that were described constitutes little more than statistical noise.[42]

Internet and other data communications users are major sources of increased BOC revenues. A second key flaw that is common to the BOC studies is that they have each ignored altogether the significant amount of revenue that these companies currently derive from the growth of Internet and on-line traffic. As we discuss in greater detail below, the BOCs are uniformly incorrect in their claim that they derive no revenues from calls placed to ISPs and ESPs — that such calls are "free" to the calling party. This attempt to disclaim the presence of substantive revenues fails to acknowledge the fact that the local rate structures applicable for these calls impose the responsibility for payment upon the *calling party* rather than on the *recipient* of the call.[43] Thus, the mere fact that the ESP that *receives* an incoming call from an Internet user does not pay for its receipt does not make the call "free" or non-revenue-producing to the ILEC.

The fact that calls that are *sent paid* by their originators are delivered without charge to their intended recipients is entirely analogous to the case of a large-volume mail recipient. One example of such a recipient is a local telephone company, which receives massive amounts of mail from customers containing checks in payment of monthly telephone bills. Each envelope received by the local telephone company carries a 32-cent stamp affixed by the sender, which covers the costs of sorting, routing, and delivering the envelope and its contents. Although the Postal Service undeniably does incur costs to physically deliver the mail, it does not charge the recipient for such deliveries, because the 32-cent stamp on each envelope is fully compensatory. Indeed, no one has ever seriously suggested that large volume mail recipients should pay an *additional* fee for receiving such mail.

If the Postal Service were to adopt the methodology of the BOCs in examining the costs of large volume mail deliveries, it would have to confine its examination solely to the

---

42. Bell Atlantic's total 1995 additions to plant in service was approximately $2.39-billion, the vast majority of which was spent to expand and upgrade circuit-switched network capacities to accommodate general growth in subscriber access lines and in public switched network usage. Between 1990 and 1994, Bell Atlantic's annual construction budget varied between $2.13-billion and $2.39-billion. (Sources: ARMIS, 43-02 Report, 1995; Annual Reports Form M and 10K of Bell Atlantic-Delaware, C&P of D.C., C&P of Maryland, New Jersey Telephone, Bell of Pennsylvania, C&P of Virginia and C&P of West Virginia.) Indeed, these figures dwarf even the $30-million that the Bell Atlantic study estimates is its total annual cost, including upgrades and all other expenses, of serving ISPs. (Bell Atlantic study at 15.)

43. It is important to note that under access charges the originator of the call to an interexchange carrier does not directly pay for the access connection. Instead, the charge for access is billed to the IXC, which then bills its customer for the end-to-end long distance call. The BOC studies are unclear as to whether they would forego the charges they derive from what are currently local calls to ESPs under an access charge scenario, although that would certainly seem to follow. Note also that the reclassification of ISP/ESP calling from the state to the interstate jurisdiction will affect jurisdictional cost allocations under Part 36 of the FCC's Rules, and may require adjustments in the authorized revenues of ILECs at both the state and federal levels.

delivery activity (i.e., to the costs of the trucks that are used to transport the incoming ma and, like the BOCs, would have to ignore entirely both (a) the fact that the postage h already been paid, and (b) costs are incurred when delivering first-class mail to "ordinar (i.e., non-bulk) mail recipients by letter carriers.[44] Such a study would reach the erroneo conclusion that the recipients of mail should be charged in order to cover the cost delivery, for precisely the same reason that the BOC studies reached their own similar erroneous conclusions. As the postal service analogy demonstrates, this methodolo requires that one ignore material facts, limit measurements to selected situations, and fail provide a comprehensive examination of all elements of the service provisioning a delivery processes.

Local telephone calls are either paid for by the calling party on a per-call basis, or a "flat-rate" basis, whereby a fixed monthly fee is imposed for unlimited calling on a sing subscriber access line. These state-regulated rates typically exceed the underlyi incremental cost of local network usage, and are thus compensatory to the ILEC Moreover, while it is often claimed that residential exchange access service is priced belc cost, such claims go to the *access line* (i.e., loop) portion of the service, not to local usag Local usage, whether provided on a measured- or flat-rate basis, is almost invariably pric well in excess of incremental cost.[46] Moreover, to the extent that the demand f *additional residential access lines* is being satisfied through the use of capacity that already in place (most ILECs have for many years been providing a minimum of two pa per residential premises, sometimes as many as four distribution pairs in upsca neighborhoods[47]), the out-of-pocket cost of furnishing additional lines to existi residential premises is extremely low.

---

44. Indeed, such costs are likely *higher*, on a per-piece basis, than for bulk deliveries.

45. While it may be possible to identify isolated cases of extremely high-use flat-rate subscribers, these are ra and certainly not confined to data communications users. Minutes of use from ESP users and all other users a included in the calculation of average usage to determine flat rates, so the fact that a particular high usa telephone customer pays a flat rate does not mean that, on the whole, the rate is not compensatory. As a result, t costs incident to supporting average use levels are well below the monthly flat-rate usage charges that may be pa by residential (or, in certain states, business) subscribers.

46. In its recent *Interconnection Order I* in CC Docket 96-98, the FCC estimated "proxy costs" on a To Element Long Run Incremental Cost (TELRIC) basis for local end office and tandem switching at 0.2 to 0.4 cei and 0.15 cents per minute, respectively. *See Interconnection Order I* at para. 811 and para. 824. A typic interoffice call will involve two switching operations (0.4 to 0.8 cents) and sometimes (but usually in a minority cases) a tandem switching operation as well. Thus, the *maximum* switching cost for a local call is 0.95 cents p minute, with more typical costs running in the 0.4 to 0.8 cent range. In some cases, a 0.10 cent local transport co may also apply. Local usage charges, whether measured or flat-rated, average between 2 and 3 cents per minu See also footnote 14, *supra.*

47. *See, e.g.*, Deposition of William L. Vowell, March 11, 1996, California PUC, R.93-04-003/I.93-04-002, vo 1, at 143.

Business access lines are not priced below cost. Hence, the monthly fees that ESPs and ISPs pay for their business lines cover the costs of providing and maintaining those lines. Additionally, the BOC studies ignore the fact that even ESPs that provide their service via analog business lines (Option 3 of Figure 3), generally do *not* subscribe to business service alone. Rather, in order to provide their on-line services via the circuit-switched network, ESPs must order from the ILECs a variety of special features in addition to basic business service, features that in most instances bring the total charges paid by ESPs substantially above the basic business rates cited in the Bell Atlantic and Pacific Telesis studies. For example, ESPs and other data services that maintain a modem pool accessible via a single dial-up number will in most cases have to subscribe to a additional features like hunting or direct inward dialing (DID), which may carry charges in addition to that for basic business dial-tone service.

The growth of ESPs/ISPs has created significant revenue streams for the BOCs directly attributable to data traffic on the PSTN.

While their studies have told one story about the impact of on-line service use on the PSTN, recent BOC statements tell quite a different one. Pacific Bell has announced that it plans to hire 2,500 new employees in 1997, in part to meet what John Britton, a Pacific Bell spokesman, calls "an incredible cultural demand that has developed for additional phone lines."[48] This demand is evident nationwide. In a 1995 Company Profile, for example, NYNEX reported that it had experienced "record growth" in its core telecommunications business.[49] A significant fraction of that growth has occurred as a result of a tremendous increase in demand for additional residential access lines. Indeed, within the NYNEX region, additional residential lines increased 9.6% in 1995, and 10.1% in 1994, compared with the average annual growth rate for all residential lines, which remained constant at approximately 3.4% in both years. Even business line growth rates, which were 4.5% in 1995 and 4.4% in 1994, lagged well behind the growth in additional residential lines.[50] On a national level, the statistics for additional line growth are even more striking.

Before 1990, additional residential lines were subscribed to by between 2.5% and 3.0% of the total number of households with telephone service in the United States. Since 1990,

48. "Demand for Lines Spurs Pacific Bell Hiring," Knight-Ridder/Tribune Business News, reported by George Avalos, *Contra Costa Times*, Walnut Creek, California, January 11, 1997.

49. NYNEX, *1995 Profile & Statistics*, NYNEX Corporation, 1996, at 6.

50. *Id.*, at 33.

however, that number has skyrocketed, increasing to 9.2% by 1992, and 14.7% by 1995.[51] Recent BOC earnings reports suggest that further growth was experienced in 1996, suggesting that the 1996 second line penetration rate may well have reached 16% or higher.[52] Since the growth in additional access lines has roughly paralleled the growth in the number of Internet users (see Figure 4), at least a portion of those additional lines (and the revenues derived therefrom) are attributable to subscribers who use them exclusively or primarily for calling ESPs/ISPs. ETI's analysis indicates that the incremental revenues inuring to the ILECs from these additional residential access lines for the 1990-95 period *have exceeded $3.5-billion nationally.*[53]

In 1995 alone, this analysis (see Table 3, following) shows that some 6-million residential subscriber lines nationally were used exclusively or primarily for on-line access. Total (nationwide) revenues from additional residential access lines whose installation was driven by the subscriber's use of on-line services reached $1.4-billion (see Table 4, following). Thus, even putting aside for a moment the revenues that the ILECs receive directly from ESPs/ISPs as well as any additional local usage charges that are paid by ISP/ESP users, the second residential access line revenues alone *far exceed* even the inflated costs that the BOCs seek to attribute to data traffic. Indeed, accepting Bellcore's own estimate that reinforcing the PSTN will cost some $35-million per year per RBOC (for a total of $245-million, nationally),[54] additional access line sales stimulated by the growth of on-line services *alone* generated revenues that exceed this figure by a factor of six.

The authors of this Study have performed an analysis of proprietary 1996 ESP usage data which indicates that on average approximately 10% of ESP users account for between 60% and 70% of total ESP hours of use. The data further indicate that the majority of ESP users fall into the range of 0 to 10 hours per month. Because they spend so much time on-line, users in the top 10% are much more likely to have second lines for their on-line usage. These heavy users are therefore a direct source of revenues for the ILECs, through the monthly telephone bills for their second lines.

---

51. FCC Industry Analysis Division, "Percentage Additional Residential Lines for Households with Telephone Service (End of Year Data)" (chart), December 6, 1996.

52. "Four Baby Bells Report Healthy Results," *Wall Street Journal*, October 18, 1996.

53. This estimate is based upon reported national average rates for residential telephone service (including both recurring and nonrecurring charges). Average rates for each year, 1990-1995, excluding taxes and subscriber line charges, and average installation charge, 1990-1995, from FCC, *Monitoring Report*, CC Docket No. 87-339, May, 1996, Table 5.7. (See Appendix A to this report for the data and calculations that support these values.)

54. Bellcore study, at 4.

Year	Households with telephone service	Additional Residential Lines	Estimated Additional Lines Dedicated to On-Line Use
1990	88,350,000	3,870,325	0
1991	89,379,000	6,537,450	1,311,024
1992	90,997,000	8,355,973	2,174,846
1993	93,036,000	8,845,773	2,385,085
1994	93,694,000	11,499,550	3,697,561
1995	94,233,000	13,890,593	6,043,721

Table 3. Nationally, in 1995 the demand for some 6-million residential subscriber lines can be attributed principally to on-line access. Sources: Households with Telephone Service, Additional Res. Lines: FCC Industry Analysis Division, "Percentage Additional Residential Lines for Households with Telephone Service (End of Year Data), Chart, Dec. 12, 1996; Lines Dedicated to On-Line Use: See Appendix A to this Study.

Year	Monthly Revenues from On-line Lines	Annual Recurring Revenues	Installation Revenues	Total Revenues
1990	$0	$0	$0	$0
1991	$21,841,659	$262,099,905	$73,417,340	335,517,245
1992	$36,254,679	$435,056,151	$65,965,749	501,021,900
1993	$39,997,872	$479,974,469	$41,597,961	521,572,430
1994	$62,229,950	$746,759,400	$105,006,551	851,765,951
1995	$103,951,999	$1,247,423,985	$178,397,610	1,425,821,595
	TOTALS	**$3,171,313,910**	**$464,385,211**	**$3,635,699,121**

Table 4. Cumulative ILEC revenues derived nationwide from residential access lines used for dial-up access to ESPs/ISPs since 1990 total some $3.6-billion. Source: Appendix A to this Study

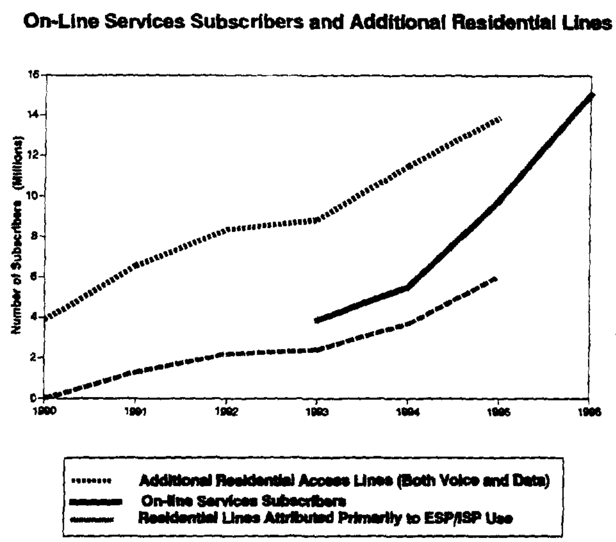


Figure 4. A strong relationship exists between the overall growth of the Internet and otl on-line services and the growth in demand for additional residential access lines.

Sources: Additional Residential Access Lines and Residential Lines Attributed Primaril to ESP/ISP Use: See Table 3. On-line Services Subscribers: Information and Interacti Services Report (IISR), Quarterly On-line Census Data, October 25, 1996, October 20, 1995, October 7, 1994, September 24, 1993.

Use of the public telephone network for Internet and on-line service access is not out of proportion to the subscriber access lines that ha been installed to support such use.

While the various BOC studies seek to portray users of Internet and other on-li services as somehow contributing disproportionately to the capacity demand on the PST they offer no actual data to support this claim. Use of the PSTN for on-line service acc would be disproportionate if the relative proportion of total PSTN local minutes of ι (MOU_{PSTN}) associated with ISP/ESP usage (MOU_{ESP}) exceeded the proportion of total PS access lines ($ACCLINE_{PSTN}$) that can be associated with lines used for calls to ISPs/ES ($ACCLINE_{ESP}$). That is, if

$$MOU_{ESP} / MOU_{PSTN} > ACCLINE_{ESP} / ACCLINE_{PSTN}$$

In fact, no such disproportionate relationship can be identified. As this Study has already shown, through the end of 1995 a total of approximately 6-million additional residential access lines can be specifically attributed to on-line service demand. To these must be added the roughly 4-million ESP/ISP users who gain access via the same telephone line that they use for their voice conversations.[55] These lines represent approximately 6.8% of the total 147-million business and residential access lines in service as of the end of 1995.[56]

While it is difficult to estimate precisely the aggregate amount of ISP/ESP usage that is provided on a dial-up basis (rather than through a direct network access connection to, for example, a university or corporate Local Area Network), a reasonable assumption is that, on average, each of the roughly 10-million on-line service users (as of the end of 1995) accounted for 15 hours per month of local calling to an ISP/ESP.[57] That volume of usage would account for some 108-billion MOUs annually, or 5.4% of the 2-trillion total annual local MOUs for all US ILECs combined.[58] While these data can certainly be refined, there is no specific basis to believe that more precise estimates will yield significantly different results. Overall, end user and ISP/ESP access lines combined appear to impose *less than proportionate demand* on aggregate PSTN capacity.

55. Estimate based upon ETI analysis (Table 3); "Online Audience at 9.8 Million Users," *Information and Interactive Services Report*, v. 16, n. 21, October 20, 1995, at 1. Note that this overestimates the actual number of dial-up access lines used to connect to on-line services, because it assumes that no individual subscribes to more than one on-line services at a time.

56. For complete accuracy, both the numerator and denominator of this ratio should be adjusted to remove business ESP customers with dial-up connections, since businesses generally pay some form of measured rate, and thus clearly and directly compensate the LEC for their ESP usage. This would be offset by a corresponding effect on the minutes of use figure (see footnote 57, below). Source for total business and residence access lines: FCC, *Preliminary Statistics of Common Carriers*, 1995, Table 2.10.

57. Based upon proprietary 1996 usage data for several ESPs made available to the authors of this Study, which indicate an average usage of between ten and fifteen hours per month per ESP subscriber. In light of the fact that several ESPs shifted from measured-use pricing to flat-rate pricing during 1996, it is highly probable that usage in 1995 would actually have been considerably less than fifteen hours; however, that figure is adopted here only as a very conservative estimate. Moreover, elimination of business users (See footnote 56, *supra.*) would reduce this figure as well, since (a) the 10-million user figure includes dial-up business ESP customers, and (b) the 15-hour average usage also includes business usage, which likely raises the overall average. Moreover, the ESP usage data referred to above indicates that between 30% and 40% of total ESP usage occurs during the business day, and it is likely that the majority of this usage originates from businesses that are subject to measured-rate or demand-sensitive local service pricing.

58. *See* FCC, *Monitoring Report*, CC Docket 87-339, May 1996, at Table 4.5.

The BOC studies fail to distinguish between inefficient LCM and efficient trunk port ISP/ESP serving arrangements, and attribute all ISP/ESP use to the former.

The BOC studies each generally combine all calls to on-line services together, and claim the aggregate level of traffic as a burden on the local network.[59] In reality, calls placed to ESPs and ISPs can be handled by at least two different methods, with very different implications for the burden that will be placed on the end office switch serving an ESP. Calls placed via analog modems to ESPs which are provided with Line Concentration Module (LCM) connectivity to the central office switch (Option 3 of Figure 3) occupy a line port for the duration of the call. This could lead to a potential blocking problem if the switch is not properly engineered and balanced. Many ESPs, however, utilize *trunk port* connectivity that bypasses the LCM. In so doing, they eliminate any possibility of LCM blocking. *All ESPs could be provided with trunk port connectivity*, but some may avoid this arrangement due to the tariff penalties imposed by the LECs themselves, as discussed in Section 2. Indeed, Primary Rate Interface (PRI) ISDN, which Bell Atlantic cites as the connection method used by fully 50% of ISPs in its territory, bypasses the line module, and connects at the DTC (Digital Trunk Controller), via a trunk port (see Option 1, Figure 3). *This means that calls to a PRI ISDN-equipped ISP are non-blocking in the terminating end-office switch, and will not prevent other users of the public network from placing or receiving calls.* Of course, a more accurate measure of the impact of ESP usage on a *typical* ILEC switch (as opposed to the few the BOCs single out for discussion in their studies) is no discernable impact at all.

BOC statements on the congestion issue incorrectly attribute certain service problems internal to the Internet itself as causes of claimed traffic problems on the PSTN.

In addition to their concerns with respect to the growth of on-line service usage, the ILECs also seek to attribute PSTN congestion to various ISP and Internet outages, problems that are endemic to on-line service providers and to the Internet itself and that do not directly affect the PSTN (that is, failure of Elements *6*, *7*, and *8* in Figure 1). An example can be seen in the recent keynote address by Michael Fitzpatrick, the President and CEO of Pacific Telesis Enterprises, at Wescon/96 on October 23, 1996.[60] In that speech, Mr. Fitzpatrick bundled all Internet congestion problems together as a justification for imposing

59. See, for example, the Bell Atlantic study and the Pacific Bell study.

60. "Internet Congestion: Crisis or Come On?" Speech by Michael Fitzpatrick, Wescon/96, October 23, 1996. Downloaded from Pacific Telesis Home Page, http://www.pactel.com/about/fitz102396.html, November 10, 1996.

carrier access charges on ISP/ESPs — even problems that have nothing to do with the PSTN.

For example, Fitzpatrick cited a list of "high-profile flops" that indicated growing problems with the Internet — service outages of Netcom, AOL, and an unnamed New York ISP (Element *7*), busy signals faced by customers of smaller ISPs (Element *6*), and predictions by Bob Metcalfe of an impending catastrophic Internet meltdown (Element *8*).[61] While all of the items on Fitzpatrick's list *do* signify that the ESPs/ISPs face technical challenges in the months ahead, referring back to Figure 1, not a single one of these situations either caused or was caused by any problems in the PSTN.

The busy signals faced by customers calling ISPs are hardly unique to Internet providers — there are any number of conventional voice PSTN uses that also generate excessive and pervasive busy signals.[62] Busy signals of this sort have nothing to do with traffic congestion reaching the point where blocking occurs at the end office switch. Rather, they occur simply because the entity in question, whether a data or a voice service, has not purchased a sufficient number of exchange access lines for the number of individuals who initiate calls to it. In both cases, this is deliberate. A voice user may only purchase enough lines for the number of operators answering the phone, and a data service will likely only purchase sufficient lines for the number of modems in its modem pool. Clearly, if the number of individual call attempts made at any given time exceeds the number of lines purchased by the service, busy signals result for customers, even though the switch as a whole is *not* experiencing a blocking problem.

To explain this in slightly different terms, there are two different busy signals that a user initiating a call over the PSTN may encounter. One type, the "standard" busy signal, results when the line or lines that correspond to the dialed number are all in use. The other type, the "fast busy signal" or "reorder" tone, results when all lines into the end office *switch* (or paths available to the LCM that serves the dialed number) are in use. The latter case is potentially a far more significant problem, because it means the switch (or every available interoffice trunk) is already being used to capacity and, as a result, no calls may be placed or received until some of that capacity is freed. However, standard busy signals are encountered far more frequently than reorder tones. In those cases, the problem of

61. *Id.*

62. To cite but a single example, radio stations that offer "two free tickets to the twelfth caller" engender hundreds or thousands of call attempts in an extremely short period of time, *the vast majority of which result in a busy signal.* SS7 should significantly reduce the adverse network impact of these and other recurring line busy conditions. However, to the extent that such spikes — which do not occur in the case of Internet use — do adversely impact the public network, they occur at random, making it impossible to anticipate or plan for them. In contrast, steady traffic at a regular time, like ESP traffic (which is heaviest in the late evening), is much more easily taken into account in network and switching design.

congestion is confined to the particular customer (ISP or otherwise) who orders an insufficient number of lines. And such situations are best resolved by marketplace forces: In competitive markets, customers respond to poor service by "voting with their feet." If customers consistently encounter busy signals when trying to reach an inadequately configured ISP modem pool, either they will migrate to competing providers who offer adequate access line capacity, or the ISP will order more lines. Either way, the frequency of busy signals will be reduced. And either way, the impact is limited principally to the ISP, and does not materially impact the PSTN as a whole.

Mr. Fitzpatrick also implies that the introduction of cable modems will *increase* the burden on the PSTN.[63] While there is every reason to expect that cable modems will increase traffic on the Internet, this technology, which provides far greater bandwidth than can be supported by conventional analog dial-up telephone lines, will also *remove* Internet traffic from the local telephone network altogether. It is true that some first-generation cable modems currently being tested do use the PSTN as the 'upstream' channel (i.e., from customer to service provider). However, the firms designing cable modems are certainly aware of the limitations inherent in using the circuit-switched network for data transmission. The technology is evolving away from this method, toward either wireless upstream or the use of cable in both directions. Long before cable modems become widespread, they and the associated cable television-based Internet services will have developed to the point where no PSTN use will be required.

The Internet and on-line services community is well aware of the growing pains and operational problems that have arisen in their operations, and are taking steps to address and resolve them. They need no inducement in the form of per-minute access charges to push these efforts forward. The BOCs have offered no direct evidence that congestion and outages on the Internet itself are propagating onto the telephone network or creating difficulties for the local telephone companies.

BOC efforts to apply access charges to ISPs/ESPs should be considered in the context of the BOCs' own intentions with respect to entry into and development of the Internet service market.

In considering BOC calls for access charges on ESPs and ISPs, it is important to bear in mind that the BOCs themselves are in the process of entering, or expanding their presence in, the market for on-line services. Nearly all the BOCs (Ameritech, Bell Atlantic, Pacific Bell, BellSouth, US West, and SBC Communications, Inc.) have started to provide Internet services. Presumably, any access charges imposed upon their non-affiliated ESP/ISP competitors would also apply to their own Internet businesses. However, as a

63. "Internet Congestion: Crisis or Come On?" *op. cit.* at footnote 60, *supra.*

practical matter, the *effect* of this strategy would be to escalate the costs that competing (non-affiliated) ESP/ISPs will be required to incur in order to remain in business.

In this context, it is noteworthy that ILEC concerns about Internet traffic resulting in a PSTN crisis do not seem to have deterred their own marketing efforts. In their advertising for second residential lines, many of the BOCs mention specifically that such lines are ideal for connecting to Internet services. This is taken to an extreme by a recent Pacific Telesis promotion, which offers customers who subscribe to an additional telephone line free set-up and five months of free *unlimited* Internet usage from Pacific Bell Internet.[64] While complaining that Pacific receives little or no revenue from Internet use, Pacific Telesis seems more than willing to apply the revenues it generates from additional residential access lines to support "unlimited" Internet service. Clearly, a "meltdown" is nowhere near as imminent as Pacific has sought to portray it.

64. *See,* Pacific Telesis promotional materials, downloaded from Pacific Telesis Home Page, http://www.pacbell.com/, November, 1996.